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PERFORMANCE OF ORGANIC MANURES, INORGANIC FERTILIZER AND PLANT DENSITY OF YIELD AND QUALITY OF RADISH

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ABSTRACT

A field experiment was conducted during rabi season of 2014-15 on sandy loam soil to "Effect of organic, inorganic fertilizers and plant densities on performance of radish (Raphanus sativas L.)". The experiment consisted three treatment of organic manures (control, VC @ 5 t/ha and FYM @ 15 t/ha), three treatment of inorganic manures (control, 50% RDF of NPK and 100% RDF of NPK) and two treatment of plant densities (20 x 10 cm and 30 x 10 cm), thereby making eighteen treatment combinations tested in randomized block design with three replications. Results indicated that application of vermicompost @ 5 t/ha and 100% RDF of NPK significantly higher yield attributes, yield and quality of radish over control, FYM @ 15 t/ha and control, 50% RDF of NPK, respectively. The result also indicated the plant spacing 30x10 cm significantly higher the yield attributes, yield and quality of radish over plant spacing 20x10 cm. However, TSS unchanged under different organic manures and plant densities.

KEYWORDS: FYM, NPK, Plant Density, Radish, RDF, Quality, Vermicompost and Yield

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INTRODUCTION

Radish (*Raphanus sativas* L.) is one of the most popular root crop of *rabi* season and is widely acclaimed for its excellent nutritive and medicinal values. It belongs to family Cruciferae and it has (2n=18) chromosomes. It is popular in both tropical and temperate countries. The radish leaves are rich in minerals and vitamin A (5 IU) and vitamin C (15 mg) and are roots rich in potassium (138 mg) and calcium (50 mg). The edible part of radish is modified root which develops form both primary root and hypocotyls. The pungency in radish is due to the presence of volatile isothiocynates.

FYM being rich in organic matter is required for supplementing the nutrients provided through other manure. The organic manure not only provides nutrients to plants but also improves the soil texture by binding effect to soil aggregates. Organic manure increases CEC, water holding capacity and phosphate availability of the soil, besides improving the fertilizer use efficiency and microbial population of soil; it reduces nitrogen loss due to slow release of nutrients. Vermicompost is a slow releasing & organic manure which have most of the macro as well as micro nutrients in chelated form and fulfill the nutrients requirement of plant for longer period. Vermicompost helps in reducing C:N ratio, increasing humic acid content, cation exchange capacity and water soluble carbohydrates. It also contains biologically active substances such as plant growth regulators.

The balanced fertilization in radish is important factor to boost yield attributes. Availability of nitrogen is important for growing plant as it is major indispensable constituent of protein and nucleic acid. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs, finally

leading to higher productivity. The application of nitrogen with different doses increases plant growth and yield of radish.

Phosphorus is transfer of energy within the plant system and is involved in its various metabolic activities; Phosphorus has its beneficial effect on early root development, plant growth, yield and quality (Balai, 1974). Phosphorus plays a key role in the formation of energy bound phosphate (ADP and ATP).

Potassium imparts vigour and disease resistance to the plant and plays an important role in crop productivity. It functions as an activator of numerous enzymes like pyruvic kinase activity, thus plays important role in. It is always involved in the movement of carbohydrate, therefore, accumulation of carbohydrates and soluble nitrogen compound points towards diminishing protein synthesis in case of potassium deficiency. There are evidences of direct involvement of potassium in photosynthesis and its involvement in leaf tissues metabolic activities of chloroplast. It regulates transpiration through opening and closing of the stomata by affecting activities of guard cells.

Optimum plant population is also another important aspect of crop production; wider plant spacing not only leads to excessive vegetative growth but also accelerates the evaporative losses of water from the bare ground. On the other hand, the struggle for existence increases with increasing plant population because of severe competition for light, water and nutrients.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2014-15 at Department of Horticulture, College of Agriculture, Jobner, in a randomized block design with three replications. The soil was loamy sand in texture, alkaline in reaction (pH 8.1), low in organic carbon (0.16 %), low available nitrogen (130 kg/ha), medium available phosphorus (15.1 kg P_2O_5/ ha) and medium in potassium (140 kg K_2O/ha) content. The experiment consisted three treatment of organic manures (control, VC @ 5 t/ha and FYM @ 15 t/ha), three treatment of inorganic manures (control, 50% RDF of NPK and 100% RDF of NPK) and two treatment of plant densities (20 x 10 cm and 30 x 10 cm), thereby, making eighteen treatment combinations. Fertilizers were applied as per treatment through Urea, SSP and MOP at the time of sowing as basal dose and split application of urea at top dressing. The radish cv. 'Pusa Rashmi' was sown on 8th September 2014 using seed rate of 10 kg/ha with a row spacing of 20x10 cm and 30x10 cm. The 6-10 days interval irrigations was applied during growing season. Intercultural operations *viz.*, thinning, hoeing and weeding were followed after 20 days of sowing to maintain recommended spacing and weed control. Two hand weeding during growing period and harvest maturing in 50 to 55 days after sowing and observations on tagged plants were recorded.

RESULTS AND DISCUSSIONS

Yield Attributes and Yield

Organic Manures

Results indicated that application of vermicompost @ 5 t/ha significantly higher length of root, diameter of root, fresh weight of root and yield of radish over control and FYM @ 15 t/ha (Table 1). Vermicompost, might have increased the efficiency of added chemical fertilizers in the soil, activities of nitrogen fixing bacteria and increased rate of humification which enhances the availability of both native and added nutrients in soil resulting in increase yield attributes and yield of radish (Oliveira *et al*., 2001). However, the application of FYM @ 15 t/ha significantly increased the root to shoot ratio and remained at par with vermicompost @ 5 t/ha over control. FYM also function as a source of energy for soil micro flora which bring transformation of inorganic nutrients present in soil or applied in the form of fertilizers in readily

utilizable form by growing plants (Yawalker *et al*., 2007 and Choudhary *et al*., 2007).

Inorganic Manures

The results further indicated that application of 100% RDF of NPK significantly higher the length of root, diameter of root, fresh weight of root and yield of radish over control and 50% RDF of NPK (Table 1). The application of 100% recommended dose of N and P favoured the metabolic and auxin activites in plants and ultimately resulted in increased weight of root (Kumar, 2004). However, the application of 50% RDF of NPK significantly increased the root to shoot ratio and remained at par with 100% RDF of NPK over control.

Plant Density

The plant spacing 30x10 cm significantly super over plant spacing 20x10 cm in case of plant length of root, diameter of root, fresh weight of root and yield of radish (Table 1). The beneficial effect of spacing on yield attributes and yield might be due to enhanced supply of macro and micro nutrients during entire growing season. Growth of plants becomes more intense with an increase in the competition for light; however, as the competition for light increases further, an individual plant's growth rate become very low because of the shading effects. Similar result was finding of Khatun *et al*. (2011) and Lavanya *et. al*. (2014). However, plant spacing 20x10 cm significantly increased the root to shoot ratio and remained at par with plant spacing 30x10 cm.

Effect on Quality Parameters

Organic Manures

Application of vermicompost @ 5 t/ha significantly higher ascorbic acid, nitrogen content in root and leaves over control and FYM @ 15 t/ha (Table 2). The increased photosynthetic efficiency and nutrient concentration in plants seems to be major factor responsible for higher NPK content of root under the influence of vermicompost application (Choudhary, 2006 and Gupta, 2011). However, total soluble solid (TSS) unchanged under different organic manures. Application of FYM might have improved chemical and biological properties of soil and enabled plant roots in better utilization of nutrients by crop. The protein content in root infact is a manifestation of root nitrogen content. The similar result was findings of Yadav *et al*. (2006), Garhwal *et al.* (2007).

Inorganic Manures

The results indicated that the application of 100% RDF of NPK significantly higher the ascorbic acid, total soluble solid (TSS), nitrogen content in root and leaves over control and 50% RDF of NPK (Table 2). The quality attributes were found superior under higher level of N and P (100% RDF of NPK) then control and lower level (50% RDF of NPK). Similar result was Evers (1989).

Plant Density

The results further indicated that plant spacing 30x10 cm significantly higher ascorbic acid, nitrogen content in root and leaves with compare to plant spacing 20x10 cm (Table 2). This enhancement might be due to better moisture holding capacity, supply of micronutrients and availability of major nutrients in soil due to favourable conditions created by spacing. The wider spacing of 30 x 10 cm showed significant superiority over other spacing for all these growth characters. result was findings of Preeti *et al*. (2009), Grabowska *et al*. (2009) and Lavanya *et al*. (2012). Similar However, TSS unchanged under different spacing of plant.

CONCLUSIONS

On the basis of the results obtained in the present investigation, it may be concluded that application of vermicompost 5 t/ha and 100 % RDF of NPK and plant spacing 30x10 cm may be considered as best treatment in terms of yield and quality of radish.

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APPENDICES

Table 1: Effect of Organic Manures, Inorganic Manures and Plant Density on Yield Attributes and Yield of Radish

Treatments	Length of Root (cm)	Diameter of Root (cm)	Fresh weight of Root (g)	Root: Shoot Ratio	Yield (q/ha)
Organic Manures					
M_0: Control	21.30	3.13	139	1.93	167
M_1: Vermicompost @ 5 t/ha	30.18	4.31	200	2.28	232
M_2:FYM @ 15 t/ha	27.07	3.43	193	2.35	215
SEm ±	0.85	0.30	2.02	0.11	1.88
CD (P= 0.05)	2.43	0.86	5.78	0.31	5.37
Inorganic Manures					
F_0: Control	20.36	2.67	141	1.93	167
F_1: 50% RDF of NPK	27.84	3.66	193	2.36	220
F_2: 100% RDF of NPK	30.35	4.54	199	2.26	227
SEm ±	0.85	0.30	2.02	0.11	1.88
CD (P= 0.05)	2.43	0.86	5.78	0.31	5.37
Plant Density					
S1: (20 x 10 cm)	22.15	3.15	175	2.26	192
S2: (30 x 10 cm)	30.22	4.10	180	2.10	217
SEm ±	0.69	0.25	1.65	0.09	1.53
CD (P= 0.05)	1.98	0.70	4.72	0.25	4.39

Table 2: Effect of Organic Manures, Inorganic Manures and Plant Density on Quality of Radish

Treatments	Ascorbic acid (mg/100g)	TSS (%)	Nitrogen content (%)	
			Root	Leaves
Organic Manures				
M_0: Control	8.88	5.79	1.08	2.21
M_1: Vermicompost @ 5 t/ha	12.52	6.55	2.15	3.39
M_2:FYM @ 15 t/ha	10.59	6.08	1.57	2.61
SEm ±	0.56	0.38	0.18	0.25
CD (P= 0.05)	1.59	NS	0.51	0.72
Inorganic Manures				
F_0: Control	9.03	4.76	0.96	1.97
F_1: 50% RDF of NPK	10.66	6.25	1.66	2.75
F_2: 100% RDF of NPK	12.31	7.41	2.18	3.48
SEm ±	0.56	0.38	0.18	0.25
CD (P= 0.05)	1.59	1.08	0.51	0.72
Plant Density				
S1: (20 x 10 cm)	9.85	6.00	1.15	2.35
S2: (30 x 10 cm)	11.48	6.28	2.05	3.12
SEm ±	0.45	0.31	0.15	0.21
CD (P= 0.05)	1.30	NS	0.42	0.59